



Encoding of Guideline III: Modeling Drug Information

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Available from previous sessions

- Formal statements to be encoded
- An ATP3 knowledge base with
 - Concept hierarchy
 - Eligibility criteria, goals, and risk groups
 - Clinical algorithm
- Working EON/ATHENA test environment



Goals of this session

- Understand how to model drug information
 - “Drug Usage”: indications, contraindications, drug partners,...
 - “Guideline Drug”: Choice of specific drugs and dose levels
- Understand how to make detailed drug recommendations in DSS



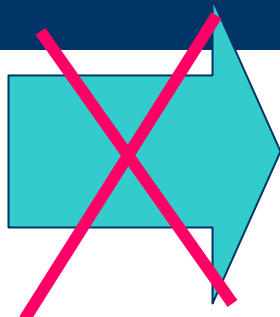
Outline

- “Drug Usage”
 - Modeling indications, contraindication, & other relationships
 - Use to evaluate drugs to add
- “Guideline Drug”
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 - Use as formulary preferred drug
 - Use dose information to recommend increasing dose



“Drug Usage” and Behavior of DSS

- Strong contraindication
- Drug Partner to avoid



Recommend Drug

- Compelling indication
- Relative indication
- Relative contraindication



Recommend Drug

- Preferred drug: specific drug to add (formulary)



Recommend Simvastatin



Generated Recommendations

[Recommendations](#) [Precautions](#) [Assumptions](#) [Lifestyle](#) [Adherence](#) [Glossary](#) [BP-Prescription Graphs](#)

- Prescription(s) for lisinopril has(have) NOT BEEN FILLED RECENTLY.
- Consider INTENSIFYING drug treatment: BP ELEVATED based on most recent available BP.

Compelling Indication Relative Indication Strong Contraindication Relative Contraindication Adverse Event

Consider one of the following therapeutic possibilities	Click here for important ...	Reasons	Click here to provide ...
Increase dosage of lisinopril	Info		Feedback
Add Cardioselective Beta Blocker (metoprolol)	Info	Myocardial Infarction	Feedback
		Diabetes	
		Depression	
Add Thiazide Diuretic (HCTZ)	Info	Diabetes	Feedback
		Hypertension	



Drug Usage properties

Link to concept in drug hierarchy

Link to specific drug and dosing details

Indications and contraindications

Cardioselective Beta Blocker (instance of Drug_Usage,...

Label
Cardioselective Beta Blocker

Drug Class Name
Beta-Blockers-Cardioselective

Formulary Preference
atenolol
metoprolol

Absolute Contraindications
Bronchospastic disease
Heart Block
Unspecified Heart Block

Relative Contraindications
Depression
Obstructive Pulmonary Disease
Sick Sinus Syndrome
Amiodarone

Drug Partners
Thiazide Diuretics

Side Effects

Collateral Action
alpha blocker monotherapy rec
Add Beta blocker and DM
Add Beta Blocker to Diltiazem (n
Add Beta blocker and PVD

Compelling Indications
Myocardial Infarction (Secondar
Uncomplicated Hypertension
Isolated Systolic Hypertension
Myocardial Infarction

Relative Indications
Atrial Tachycardia
Angina
Atrial Fibrillation
Hyperthyroidism

Drug Partners To Avoid
guanabenz



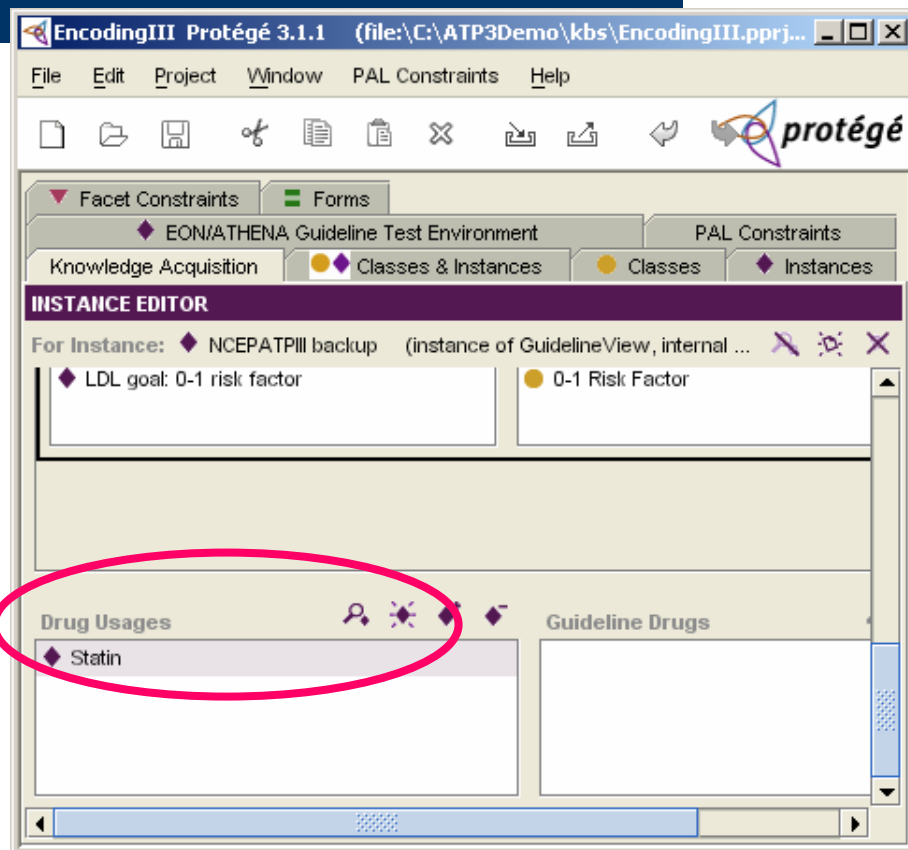
Workshop Activity 1: Adding indications/contraindications

- Statins
 - **Compelling Indication:** LDL outside goal range
 - **Absolute contraindication:** Active or chronic liver disease
- Bile acid sequestrants
 - **Absolute contraindication:** Triglycerides >400 mg/dl



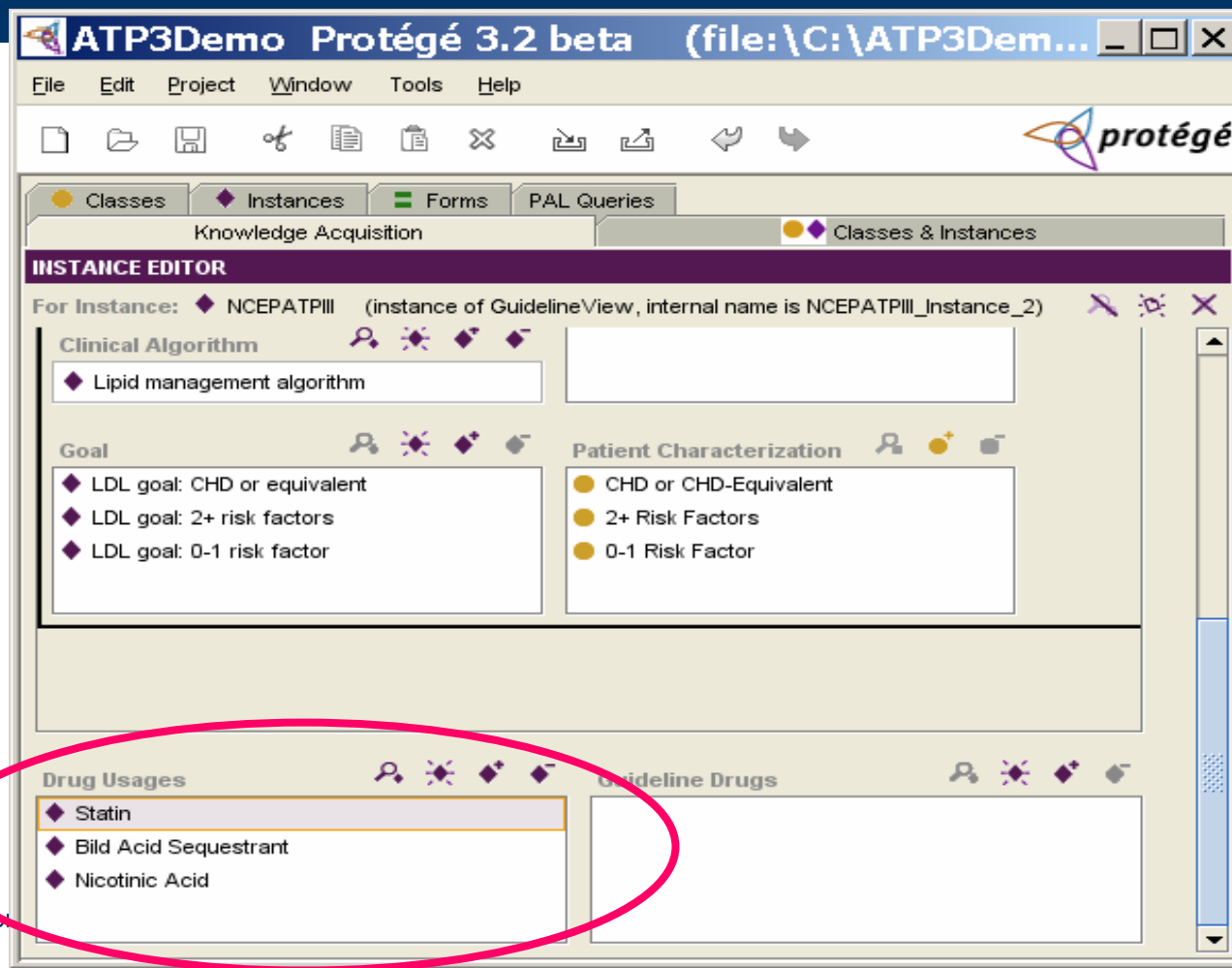
Add properties of drug class

- Demonstration
 - Create Drug Usage instance: Statins
 - Add compelling indications and absolute contraindications of Statins





Your turn: Create other drug usage instances





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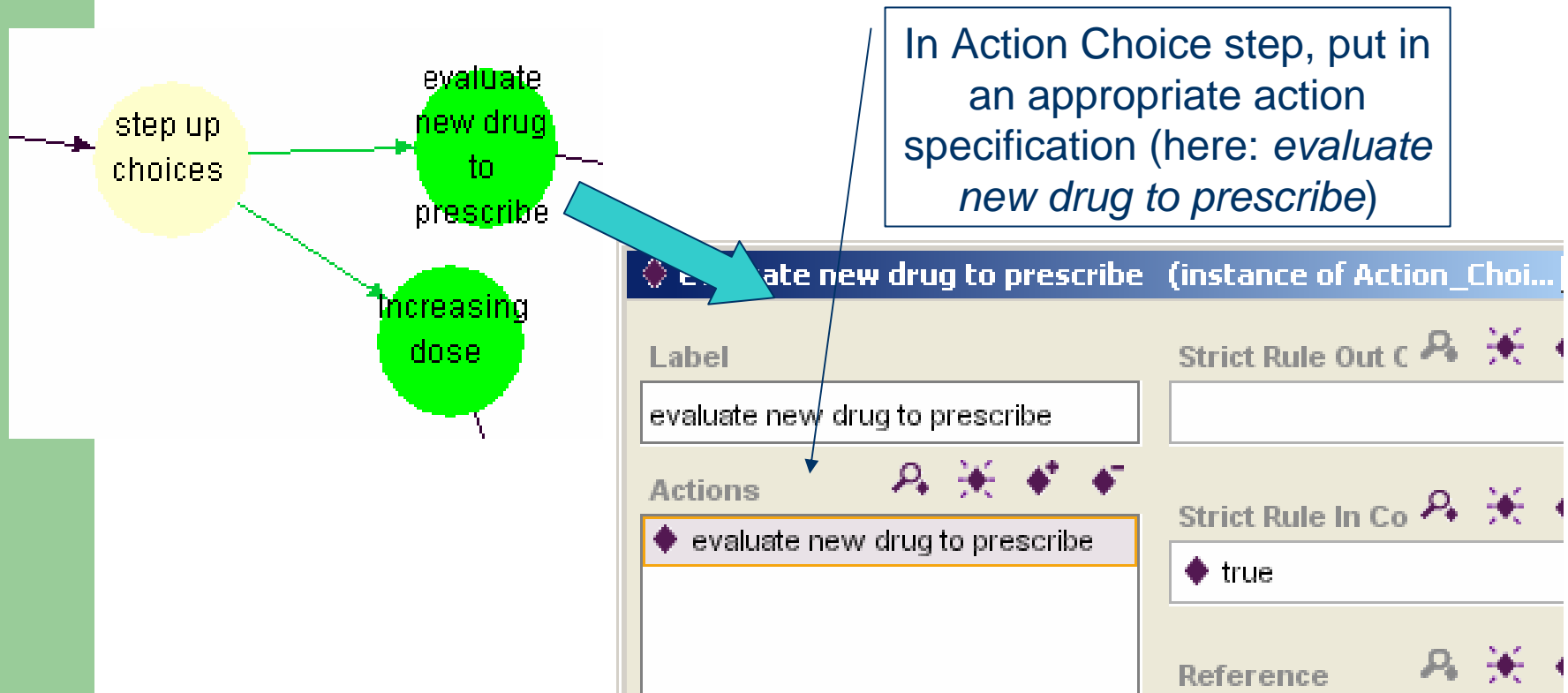


Adding drug recommendation

- Patient scenario: Low Risk category not on any lipid-lowering drug
- Recommendations:
 - Order lipid profile
 - Encourage maintenance of therapeutic lifestyle changes
 - LDL not at goal, start therapeutic lifestyle changes
 - LDL not at goal, start lipid-lowering therapy



Use of Drug Usage in ATHENA HTN





Actions that make use of drug usage information

- ▼ Activity_Act
 - Modify_Activity
 - Start_Activity
 - Step_Down_Activity
 - Step_Up_Activity
 - Stop_Activity
 - Substitute_Activity
- Acute_Prescription
- ▶ ● Collect_Patient_Data
- ▼ ● Evaluate_Activity_Act
 - Evaluate_Current_Activity
- ▼ ● Evaluate_Modify_Activity
 - Evaluate_Decrease_Activity_Intensity
 - Evaluate_Increase_Activity_Intensity
 - Evaluate_Start_Activity
 - Evaluate_Stop_Activity
 - Evaluate_Substitution_Activity

Instance of
Drug Usage

- ATHENA-HTN
Example: Evaluate
Start Activity

evaluate new drug to

Label

evaluate new drug to prescribe

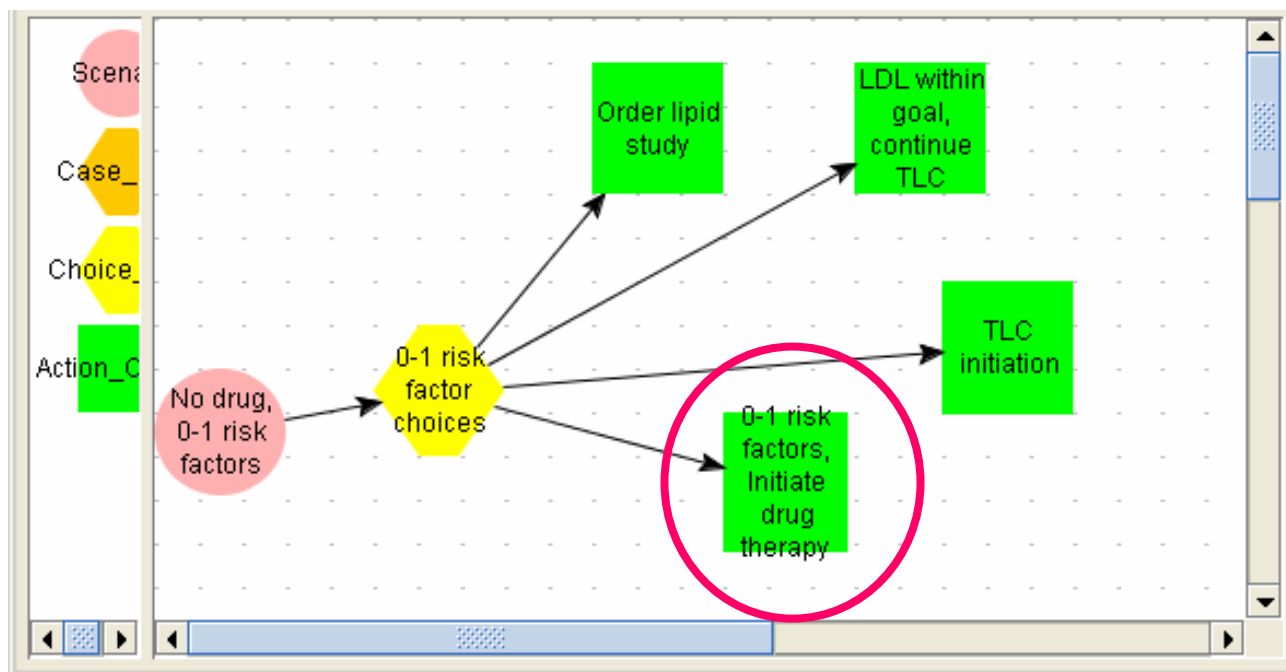
Alternatives

- ◆ Cardioselective Beta Blocker
- ◆ DHP Calcium Channel Blocker
- ◆ (non-DHP) Calcium Channel Blocker
- ◆ Potassium Sparing Diuretic
- ◆ ACE Inhibitor



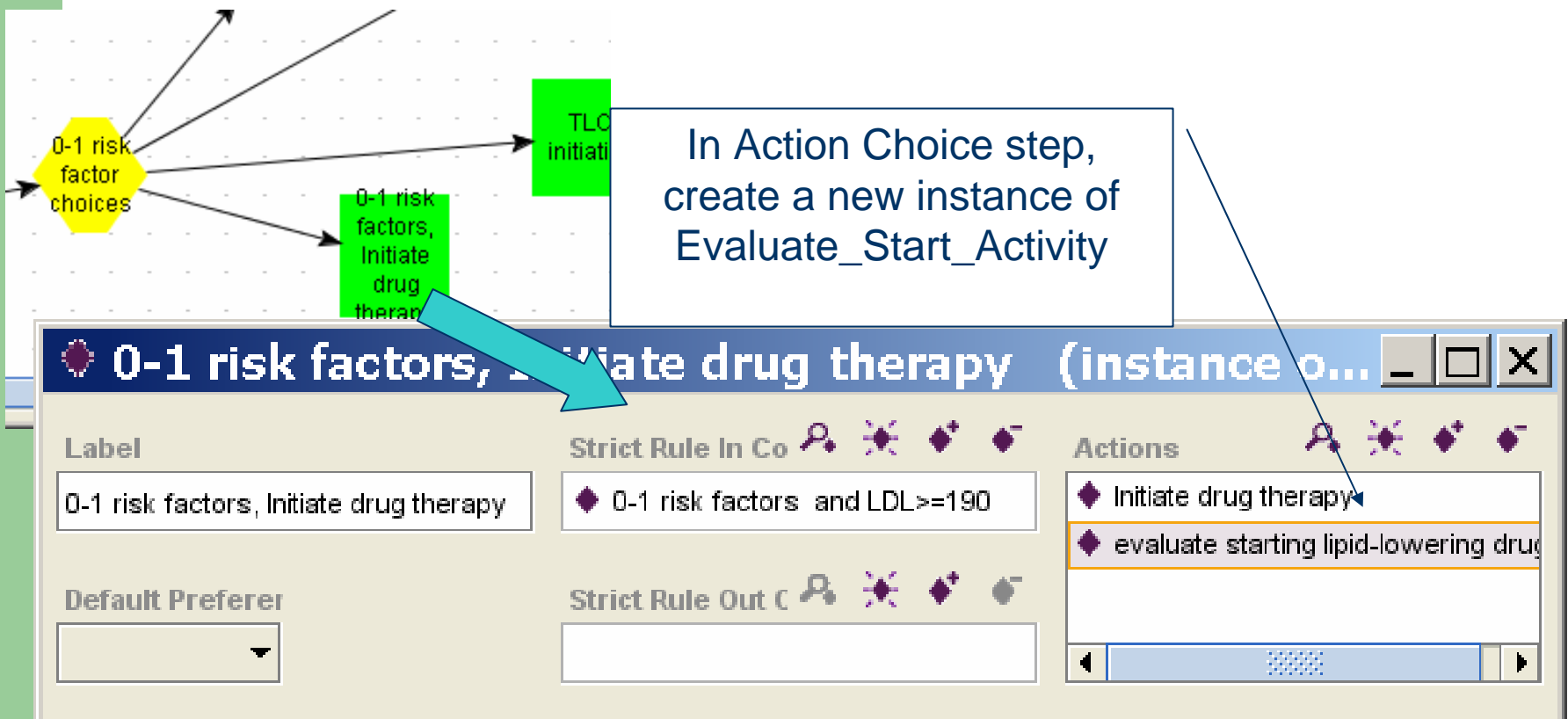
Workshop activity 2: Add add-drug recommendation to “initiate drug therapy” action

- Add drug recommendation in *Initiate drug therapy* action choice





Step 1: Create a new instance of Evaluate_Start_Activity





Step 2: Add instances of Drug Usage as alternatives

evaluate start... [minimize] [maximize] [close]

Label

evaluate starting lipid-lowering drugs

Description

Alternatives [search] [add] [remove] [refresh]

- ◆ Statin
- ◆ Nicotinic Acid
- ◆ Bild Acid Sequestrant



Step 3: Test the system

- Go to Guideline Test Environment tab
- Test with low-risk patient not on lipid-lowering therapy who has LDL of 200 mg/dL



Questions?



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“Guideline Drugs”

- Specify drug preference and dosing information at the level of generic drug

atenolol (instance of Guideline_Drug, internal n...

Label
atenolol

Generic Drug
● atenolol

Starting Dose
25.0

Dose Strength Unit
● mg

Max Recommended Dose Lev
● High_Dose

Rule In
◆ absence of myocardial infarction

Dose Level Range

abstract_value	lower_limit	upper_limit
Low_Dose	0.0	25.0
Medium_Dose	26.0	75.0
High_Dose	76.0	100.0

Rule Out



How Guideline Drug information is used: Formulary preferred drugs

Add DHP Calcium Channel Blocker (felodipine, nifedipine)
Add Cardioselective Beta Blocker (atenolol)

- Recommend adding drug class because of indications
- Select recommended formulary preferred drug



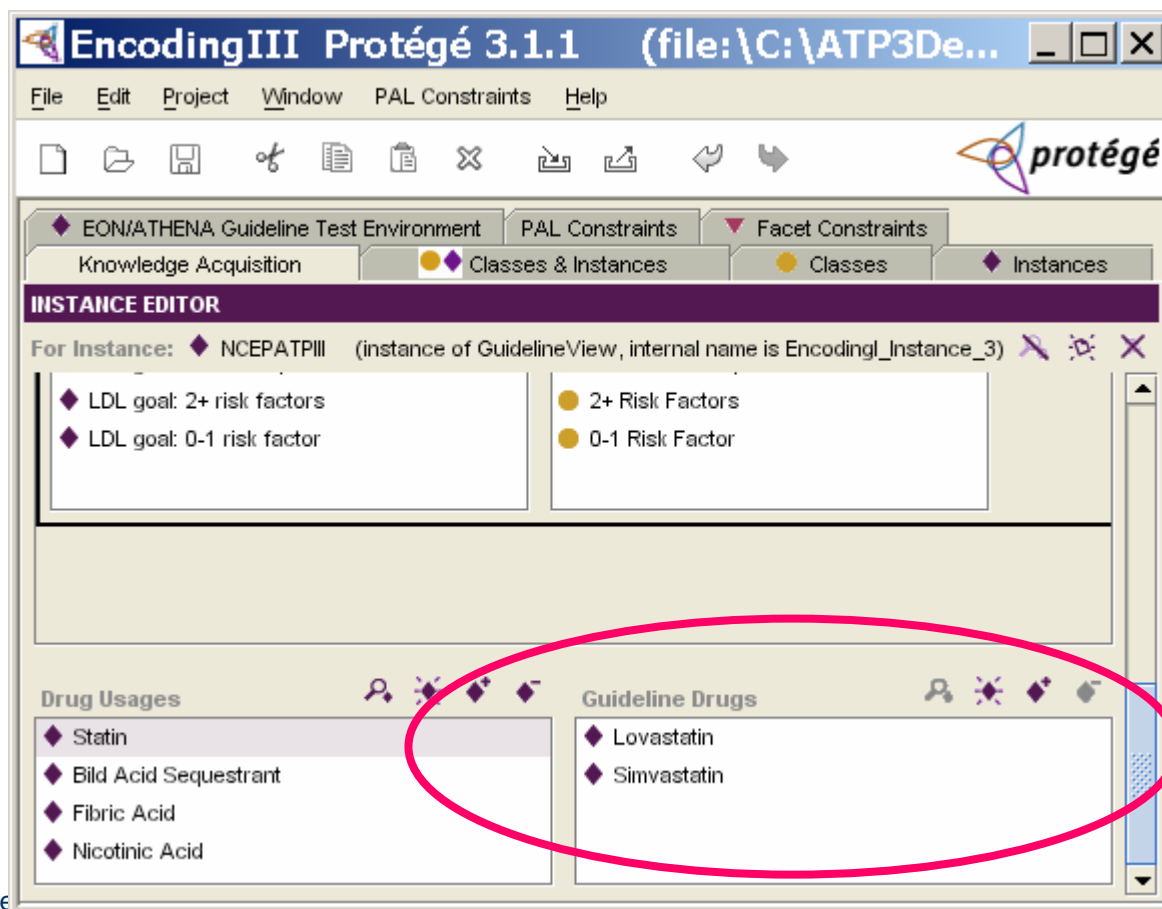
Workshop activity 3: Adding Guideline Drugs

- VA Formulary

Drug Name	Preference	Low Dose	High Dose
Lovastatin	1 st choice	20-30 mg/day	31-40 mg/day
Simvastatin	2 nd choice	40-60 mg/day	61-80 mg/day



Create instances of Guideline Drug





Demonstration: Adding Lovastatin

- First choice
 - rule in: LDL not within guideline goal range
 - rule out: presence of adverse reaction

Lovastatin (instance of Guidelin...

Label
Lovastatin

Drug Usage
Statin

Rule In
Not within guideline goal

Rule Out
Presence of adverse reaction to lov...

Generic Drug
lovastatin

Dose Strength Unit

Starting Dose
20.0

Max Recommended Dose
High_Dose(high/low)

Collateral Actions

Dose Level Ranges

abstract_value	lower_limit	upper_limit
Low_Dose(high/low)	20.0	30.0
High_Dose(high/low)	31.0	40.0



Add Simvastatin



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Workshop Activity 4: Add Lovastatin and Simvastatin as formulary preferred drugs

Statin (instance of Drug_Usage, internal name is NCEPAT...)

Label
Statin

Drug Class Name
Statin

Formulary Preference

Absolute Contraindications
Chronic Liver disease
Active Liver Disease

Relative Contraindications
Usage of drugs that are relative co

Side Effects

Allowed Classes
Guideline_Drug (2)

Direct Instances
Lovastatin
Simvastatin

OK Cancel



Test the system

- Run test case of low-risk patient with no med and LDL = 200 mg/dL
- Add adverse reaction to lovastatin and run the case again

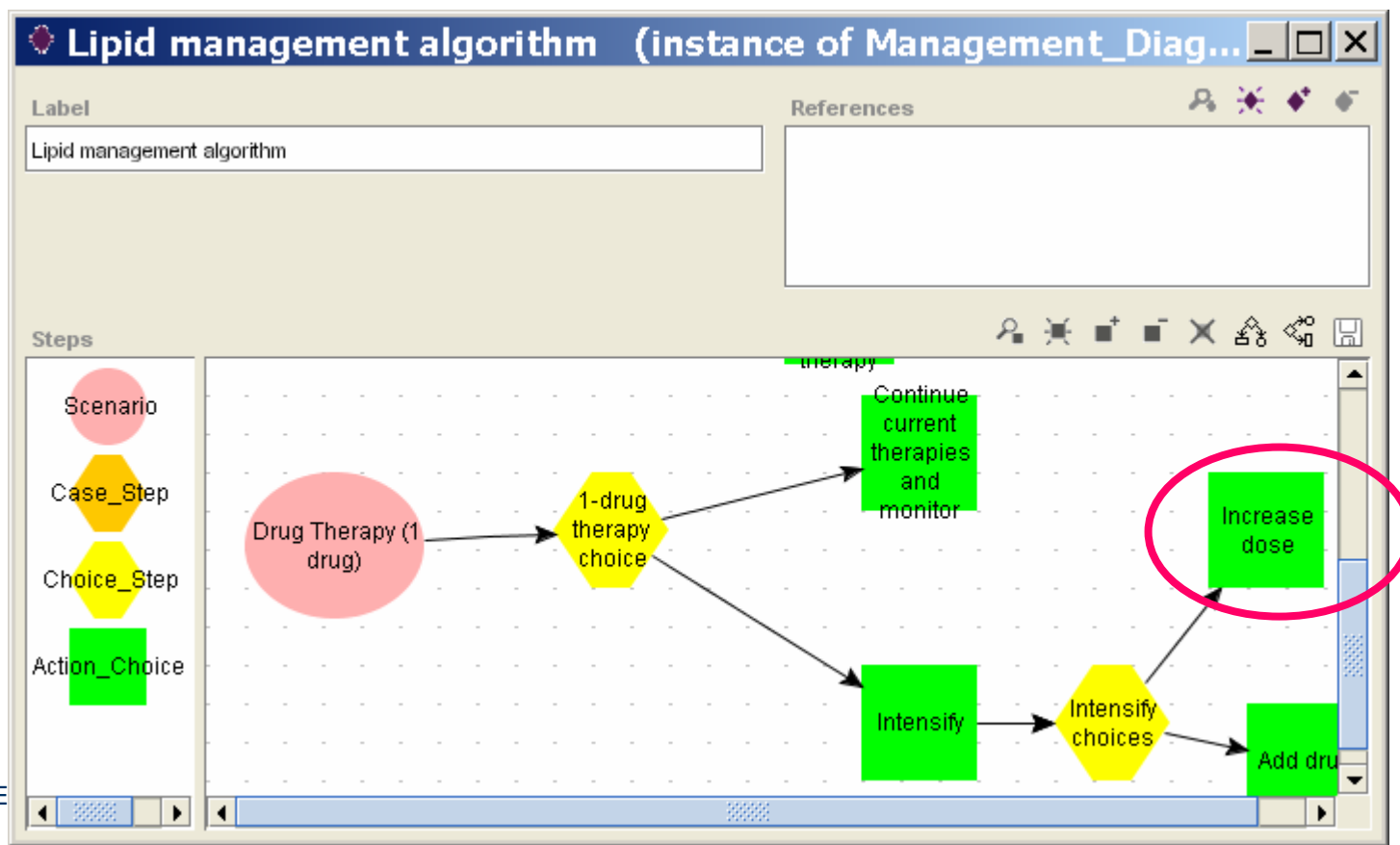


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Use dose information to recommend increasing dose





Increase dose action choice

Increase dose (instance of Action_Choice, intern...

Label
Increase dose

Strict Rule In Co
◆ There exists non-contraindicated...

Actions
◆ consider increasing dose

Default Preferer
▼

Strict Rule Out C

Followed By
◆ No recommended drug to add ani...

References



Strict rule-in criterion for increasing dose

- There exists a prescription for which
 - The prescribed drug is not contraindicated
 - The prescribed drug is a Guideline Drug
 - The daily prescribed dose $<$ lower limit of the maximum dose level



Bad news: Strict rule-in criterion for increasing dose is complex

There exists non-contraindicated drug that is not at maxi...

Name	Range
ere exists non-contraindicated drug that is not at maximum dose	(defrange ?drug_usage :FRAME Drug_Usage) (defrange ?condition :FRAME Note_Entry) (defrange ?contraindication :FRAME Medical_Conditions_Metaclass) (defrange ?derived_contraindication :FRAME Diagnostic_Term_Metaclass)

Description

Statement

```
(or (not (down-slot-not-high mood ?med))  
    (mood ?med Authorized))  
(exists ?guidelineDrug  
  (and (= (coerce-to-class (drug_name ?med)) (generic_drug ?guidelineDrug))  
        (exists ?rangeMapping  
          (and (dose_level_ranges ?guidelineDrug ?rangeMapping)  
                (= (abstract_value ?rangeMapping) (coerce-to-class "High_Dose(high/low)"))  
                (< (daily_dose ?med) (lower_limit ?rangeMapping)) )))  
    )  
(not (exists ?drug_usage  
  (and (subclass-of (coerce-to-class (drug_name ?med))
```



Good news: Complex criterion has to be written only once

- Strict rule-in criterion for increasing dose applies to all Guideline Drug instances
- Most of the time encoders only work with Guideline Drug instances



Workshop Activity 5: Test increasing dose

- Go to EON/ATHENA Guideline Test Environment tab
- Test with low-risk patient who has
 - Lovastatin medication at 20 mg/day
 - LDL of 200 mg/dL
- Test with low-risk patient who has
 - Lovastatin medication at 40 mg/day
 - LDL of 200 mg/dL



Summary

- Modeling drug information
 - Indications/contraindications of drug classes as Drug Usage instances
 - Selection and dosing of generic drugs as Guideline Drug instances
- Drug recommendations (add, substitute, delete, increase dose) can be generated based on drug information